

[0001] METHOD AND SYSTEM WHEREIN HANDOVER INFORMATION IS
BROADCAST IN WIRELESS LOCAL AREA NETWORKS

[0002] CROSS REFERENCE TO RELATED APPLICATION(S)

[0003] This application claims priority from U.S. Provisional Application No. 60/415,727 filed October 1, 2002, which is incorporated by reference as if fully set forth.

[0004] FIELD OF INVENTION

[0005] The present invention relates generally to broadcasting handover or roaming information within a wireless local area network. More particularly, the present invention relates to providing handover information in wireless local area networks so that users may handover from wireless local area networks to alternative wireless systems whose geographic coverage areas overlap that of the wireless local area networks.

[0006] BACKGROUND

[0007] In wireless local area networks (WLAN), an access point (AP) or base station (BS) serving a particular cell broadcasts a beacon signal periodically (e.g., every 100 ms). An active WTRU scans the beacon signal and associates itself with the AP having the strongest beacon. A conventional beacon contains information corresponding to the AP such as a timestamp, beacon interval, capabilities, extended service set (ESS) identification (ID), and traffic indication map (TIM). The WTRU uses the conventional beacon to distinguish between different APs. The WTRU tracks the received signal strength (RSS) of the beacon. When the RSS becomes weak, the WTRU starts to scan for stronger beacons from neighboring APs.

[0008] The WLAN conventional scanning process can be either active or passive.

In passive scanning, the WTRU simply listens to available beacons. In active scanning, the WTRU sends a probe request to a targeted set of APs that are capable of receiving its probe. In the case of active scanning, each AP that receives the probe responds with a probe response that contains the same information that is available in a conventional beacon with the exception of the TIM. The TIM is used to alert or wake-up APs and is therefore not necessary where an AP is providing a solicited response by responding to a probe request.

[0009] In order to facilitate interoperability between WLANs and available alternative systems (i.e. other systems whose coverage areas overlap that of the WLANs), however, it is of interest to allow WTRUs operating within a WLAN to detect the presence of these alternative available systems. One approach for accomplishing this task when handing over from a WLAN to a public land mobile network (PLMN) is to perform a cell search for PLMN availability while simultaneously using the WLAN for communication. This approach may be implemented by having the WTRU's PLMN receiver on and searching for available networks while the WTRU uses the WLAN for communication. The disadvantage of this approach is that it is time consuming and requires the simultaneous activation of a WTRU's WLAN and PLMN functionality. This results in increased complexity and increased battery consumption, and does not permit the WLAN to direct the traffic to a specific PLMN network. Furthermore, this approach is limited to handover from WLANs to PLMNs.

[0010] Another approach is where the search for the availability of a specific available PLMN is done manually. With this approach, in addition to being limited to PLMNs, users must manually select one network over the other which is inconvenient and time consuming.

[0011] Accordingly, it would be desirable to provide handover information without the disadvantages and limitations of the prior art.

[0012] SUMMARY

[0013] The present invention provides a method and system for broadcasting information for handover from WLANs to available alternative systems. WTRUs can then read the alternative system information without having to do a search and may handover to any type of available alternative system, as desired.

[0014] A frequently implemented WLAN, for example, is an 802.11b network. The 802.11 standard includes a "beacon frame" to allow an access point to inform WTRUs of system parameters. This beacon frame has available information elements for future services. Some of these currently unused information elements can be used to broadcast information about available alternative systems. Rather than WTRUs tracking beacons based on RSS, the present invention enables WTRUs to access alternative system information at any time, allowing them to interact with available alternative systems, as desired. Information about available alternative systems is broadcast and may include, for example, network type, network identity, cell information about surrounding cells, and information about what services are offered by the available alternative system.

[0015] BRIEF DESCRIPTION OF THE DRAWING(S)

[0016] A more detailed understanding of the invention may be had from the following description, given by way of example and to be understood in conjunction with the accompanying drawings wherein:

[0017] Figure 1 illustrates a WLAN whose geographic coverage area overlaps with that of other available alternative systems.

[0018] Figure 2 is a prior art beacon frame structure of a beacon frame used in conventional WLANs.

[0019] Figure 3 is a beacon frame structure in accordance with the present invention.

[0020] Figure 4 is a beacon frame structure in accordance with the present

invention.

[0021] Figure 5 is a method for automatically handing over WTRUs from a WLAN to an available alternative system according to predetermined criteria.

[0022] Figure 6 is a method wherein users operating WTRUs in a WLAN may manually handover to alternative systems whose geographical coverage areas overlap that of the WLAN.

[0023] Figure 7 is a WLAN where WTRUs operating therein may handover to alternative systems whose geographical coverage areas overlap that of the WLAN.

[0024] The following terms and acronyms are used in this application:

[0025]	PLMN	public land mobile network
[0026]	GSM	global system for mobile communications
[0027]	UMTS	universal mobile telecommunications system
[0028]	GPRS	general packet radio service
[0029]	IMS	IP Multimedia System
[0030]	WLAN	wireless local area network
[0031]	CDMA	code-division multiple access
[0032]	UE	user equipment
[0033]	WTRU	wireless transmit/receive unit

[0034] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0035] By way of introduction, a wireless transmit/receive unit (WTRU) as used herein includes, but is not limited to, a UE, mobile station, fixed or mobile subscriber unit, pager, or any other type of client device capable of operating in any type of wireless environment. Exemplary types of wireless environments include but are not limited to WLANs and PLMNs. The WTRUs described herein are preferably capable of operating in both WLANs and PLMNs.

[0036] When referred to hereafter, an access point (AP) includes but is not limited to a base station (BS), Node-B, site controller, or other interfacing device in a

wireless environment. Furthermore, the terms available alternative technology and available alternative system may be used interchangeably to refer to a wireless system that a WTRU operating in a WLAN may handover to.

[0037] Referring now to Figure 1, a WLAN 10 is shown wherein the WLAN's geographical coverage area overlaps with that of various alternative technologies A, B, C. For purposes of explaining the invention, alternative technology A 14 is CDMA 2000, alternative technology B 12 is a UMTS, and alternative technology C 15 is an 802.16 network. It is important to note, however, that the alternative technologies may be any type of wireless system. Furthermore, the technologies that overlap with the WLAN may be the same type of technology being used in the WLAN. That is, an alternative technology may be the same type of system as that which a WTRU hands over from. For example, handover information may be broadcast in one 802.11b network for handing over to another 802.11b network which has a different operator but overlapping coverage areas.

[0038] For purposes of describing a preferred embodiment of the present invention, the WLAN 10 will be referred to as an 802.11b network 10. It is important to note, however, that the WLAN 10 may be any type of WLAN such as, for example, an 802.11a network, an 802.15 wireless personal area network or any other type of wireless area network.

[0039] Users operating WTRUs in an 802.11b network may wish to handover to an alternative system for a variety of reasons. For example, a WTRU may be going out of range of the 802.11b network or a user may want a higher level of security/quality of service (QoS) that is available with an alternative system such as a PLMN, for example. Furthermore, a user may want to handover because of the relative cost of an alternative system versus a WLAN, or may want to utilize the services of an alternative system that are not available on the WLAN in which the user is operating.

[0040] Regardless of the reason, handing over to an alternative technology 12, 14, 15 requires information about the availability of the alternative technologies 12,

14, 15 in the area. Pursuant to the present invention, handover information is broadcast in the WLAN 10 so that WTRUs receive the required handover information without having to perform their own search. From the handover information received by the WTRUs, the WTRUs may decide which of the available alternative technologies 12, 14, 15 with which to interact.

[0041] WLANs typically provide management information to WTRUs in the form of beacons. Referring now to Figure 2, a prior art beacon frame structure is shown and indicated generally with reference numeral 20. The beacon 20 includes a timestamp 22 which is used by WTRUs to update their local clocks thereby enabling synchronization between all WTRUs associated with a particular AP. Also included is a beacon interval 24. The beacon interval 24 represents the amount of time between beacon transmissions, allowing WTRUs to be in a sleep mode between transmissions.

[0042] The capability information 26 provides requirements that must be met by WTRUs wishing to belong to particular WLANs. The service set identifier (SSID) 28 identifies the WLAN. Typically, before associating with a particular WLAN, a WTRU must have the same SSID 28 as the AP through which the WTRU will access the WLAN.

[0043] The supported rates 30 indicates the data rates that a particular WLAN supports. For example, where an 802.11b enabled WTRU accesses a WLAN that only supports data rates lower than 11 Mbps, the WTRU will comply with this restriction and limit transmissions to below 11 Mbps.

[0044] Beacons typically include information about specific signaling methods in the form of various parameter sets 32, 34, 36, 38 as also included in beacon 20. Typically, parameter sets include frequency hopping (FH) 32, direct sequence spread spectrum (DS) 34, carrier frequency (CF) 36, and Infrastructure Basic Service Set (IBSS) 38 information. As previously explained, with active scanning, a TIM 40 is provided. The TIM 40 is periodically sent to identify which WTRUs in sleep mode have data frames waiting for them in an AP's buffer.

[0045] The prior art beacon frame structure 20 does not include information regarding handover. However, the prior art beacon frame structure 20 may be adapted so that additional information elements present in such structures 20 are used for broadcasting handover information about available alternative systems. Referring now to Figure 3, information 50 regarding available alternative technologies (i.e. alternative system information) is provided within a beacon frame to enable WTRUs to interact with available alternative systems, as desired. For a particular available alternative system for which information is broadcast, the information 50 preferably includes: the type of network (GSM, GPRS, CDMA 2000, UMTS FDD, UMTS TDD, 802.11a, 802.11b, 802.15, 802.16, Bluetooth, etc.), network identity, cell descriptions for surrounding cells, and services offered by the alternative system.

[0046] More specifically, with respect to network identity, an indication of the service provider is provided. With respect to the description of surrounding cells, the information preferably includes frequency, channel number, and cell identity related to the specific technology type. For example, in the case of GSM/GPRS systems, the cell identity information will typically include a base station identification code (BSIC). With respect to the services that are offered by the alternative system, the information 50 may also include indications of whether the alternative system offers, for example, an IP Multimedia System (IMS), a short message service (SMS), a multimedia messaging service (MMS), etc.

[0047] The information 50 may be downloaded to a WLAN for inclusion in beacons sent out by the WLAN. Alternatively, the WLAN may be equipped with devices for automatically detecting alternative technologies. Other means for providing WLANs with information 50 for broadcasting in beacons may also be implemented as desired.

[0048] Referring now to Figure 4, if there are multiple alternative systems available, they should be listed sequentially. That is, for example, in say area 3 of

Figure 1 information 60 about alternative technology A would be followed by information 62 about alternative technology B, as shown in Figure 4.

[0049] Referring now to Figure 5, there is shown a method 100 for automatically handing over WTRUs from a WLAN to an available alternative system according to predetermined criteria. For purposes of describing the present invention, the WLAN is referred to as an 802.11b network.

[0050] The method 100 begins in step 104 by determining which alternative systems are of interest. This determination may be made by a WTRU or by the 802.11b network or a combination of the two and may be based on predetermined criteria specifying when to handover to an available alternative system.

[0051] The predetermined criteria may be based on a certain minimum criteria, based on factors such as the exemplary reasons for handing over from a WLAN that were provided above, or based on any other reasons, as desired. For example, such criteria may simply be related to quality. That is, if the quality of service (QoS) falls below a predetermined value in an 802.11b (or other type of WLAN) the criteria may specify that the user be handed over to any available alternative system regardless of other factors. Alternatively, the criteria may specify that where the QoS falls below the predetermined value, the user is handed over unless the monetary cost of using the available alternative system is some percentage greater than the monetary cost of using the WLAN in which the user is currently operating.

[0052] The criteria may also be related to services, mobility, battery consumption or any other criteria related to wireless communication. The various criteria may also be combined as desired. For example, users may wish to handover to an alternative technology having MMS, but not where their battery power is below a predetermined level.

[0053] Once the alternative systems that are of interest are determined, the method 100 proceeds to step 106. In step 106, WTRUs determine which alternative systems are available (i.e. which alternative systems have a coverage area that

overlaps that of the 802.11b network which is performing method 100). As mentioned, information related to available alternative systems is obtained by the 802.11b network and broadcast in a beacon. Therefore, in step 106, WTRUs may determine which alternative systems are available by reading the 802.11b beacon frame. When reading the beacon frame, the WTRU preferably retrieves cell information about the available alternative systems (step 108). This is preferred because although an alternative system has yet to be selected, it is typically more efficient to obtain cell information (step 108) about all of the available alternative systems while reading the beacon (step 106) rather than reading the beacon again once an alternative system has been selected.

[0054] Next, in step 110, the available alternate systems are compared with the systems that are of interest. Based on this comparison, it is determined in step 112 whether any of the alternate available systems satisfy the criteria for the systems which are of interest. If no, the method 100 ends and may be performed again as desired. If yes, the method 100 proceeds to step 114 where the available alternative system that satisfies the criteria is chosen. In step 116, measurements of the chosen system's coverage area and QoS are performed. These measurements may be performed using the cell information retrieved in step 108 using procedures known to those skilled in the art.

[0055] Once the measurements are complete, the method 100 proceeds to step 118. In step 118, it is determined whether the coverage area and/or QoS of the chosen system is sufficient. With respect to coverage area, the coverage area may be deemed sufficient, for example, where upon being handed over to an alternative technology, a user is not prone to being handed over to another alternative technology or back to the 802.11b network. That is, the signal strength in the selected alternative technology would have to be sufficient to support the required communication. If the signal strength were not sufficient, the WTRU, upon being handed over, would be prone to being handed over to another technology or back to the 802.11b network. This

determination acts as a double check in that although the 802.11b network should not broadcast information related to alternative systems that cannot accept WTRUs operating in the 802.11b network's coverage area, it may be that the information has changed. For example, it may be that the information has changed due to, for example, the alternative technology becoming unavailable because of power failure.

[0056] With respect to QoS, the QoS may be considered sufficient where the QoS meets a predetermined value. The criteria for performing determination 118 (i.e. whether coverage area and/or QoS is sufficient) may be set based on operator preference as desired.

[0057] If the measurements are not sufficient, the method 100 ends and the user remains in the 802.11b network. If the measurements are sufficient, the user is handed over to the chosen available alternative system (step 120). Once handed over, the method 100 ends.

[0058] Referring now to Figure 6, a method 200 is shown wherein users operating WTRUs in a WLAN may manually handover to alternative systems whose geographical coverage areas overlap that of the WLAN. To begin, a user indicates that there is an interest in implementing a handover to an alternative system by activating a manual selection option in a WTRU (step 202). The manual selection option may be activated using any type of manual activation such as executing a button, voice activation, etc. Next in step 204, the WTRU determines which alternative systems are available by reading an 802.11b beacon frame provided by the 802.11b network as explained above (step 204). While reading the beacon frame, the WTRU preferably retrieves cell information about the available alternative systems (206). In step 208, the WTRU determines which available alternative systems the user's WTRU is capable of supporting.

[0059] In step 210, the user selects the desired available alternative system. Note, in this step, the user is preferably given the option of selecting only those available alternative systems that the user's WTRU is capable of supporting.

[0060] After an available alternative system is selected, coverage and QoS measurements are performed on the selected system in step 212. Again, as with method 100, if in step 214 the coverage area and/or QoS is determined to be sufficient, the WTRU is handed over to the selected system in step 216. Once the WTRU is handed over, the method 200 ends.

[0061] Referring now to Figure 7, a WLAN 300 in accordance with the present invention is shown. For purposes of describing the invention, however, the WLAN 300 includes an AP 302 for providing an interface between a local area network (LAN) 304 and WTRUs 306, 308 operating within the coverage area of the WLAN 300. WLANs may include any number of APs and WTRUs as desired. LANs are well known in the art, but by way of example, the LAN 304 may include a server 314 and any number of computers 316, 318...n.

[0062] As previously explained, the WLAN 300 broadcasts handover information in a beacon frame so that WTRUs 306, 308 may easily retrieve the information and handover (either automatically or manually) to available alternative systems. The handover information may be downloaded or automatically detected (periodically or in real time) to/by the WLAN 300 wherein it is distributed to APs. The handover information may be distributed or otherwise provided to the APs as desired. By way of example, handover information relevant to geographic coverage areas serviced by AP 300 may be stored in a local memory 310. When AP 300 broadcasts its beacon signal, a processor 312 may be provided so that handover information which is appropriate for the AP's 300 coverage area is accessed from memory 310 and broadcast to the WTRUs 306, 308 within that coverage area. Of course, the manner in which the handover information is provided and stored to/in the APs and the manner in which the handover information is broadcast may be implemented as desired.

[0063] Although the present invention has been described in detail, it is to be understood that the invention is not limited thereto, and that various changes can be

made therein without departing from the scope of the invention, which is defined by the attached claims.

*

*

*